Achieving supply chain resilience: the role of supply chain ambidexterity and supply chain agility

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Abstract

Purpose – This study analyzes the role of supply chain ambidexterity (SC-Ambidexterity) in developing supply chain resilience (SC-Resilience). We describe SC-Ambidexterity as a simultaneous application of supply chain adaptability (SC-Adaptability) and supply chain alignment (SC-Alignment) capabilities. We also consider the role of supply chain agility (SC-Agility) in the relationship between SC-Ambidexterity and SC-Resilience. We further suggest that the relationship between SC-Ambidexterity and SC-Resilience may be stronger in case of higher market uncertainty.

Design/methodology/approach – Based on the dynamic capabilities view (DCV) of the firm, we develop a set of hypotheses that are tested through a survey of manufacturing firms in Pakistan. The hypothesized model is tested through structural equation modeling (SEM).

Findings – The results of this study show a positive effect of SC-Ambidexterity on SC-Resilience. SC-Agility positively mediates the relationship between SC-Ambidexterity and SC-Resilience. However, our results show that this relationship does not vary at different levels of environmental uncertainty.

Originality/value – This study provides the seminal operationalization of SC-Ambidexterity in the supply chain context. It further shows the importance of SC-Ambidexterity and SC-Agility in contributing toward SC-Resilience.

Keywords Dynamic capabilities, Supply chain ambidexterity, Supply chain adaptability, Supply chain alignment, Supply chain agility, Supply chain resilience

Paper type Research paper

1. Introduction

Disruptive events such as natural calamities, man-made disasters, political and economic upheavals, occurring over the last several years have impaired supply chains with constant risks and uncertainty. Surveys show that 75% organizations face some sort of disruption in the supply chain each year (Scholten *et al.*, 2020). These unexpected disruptions are the leading source of poor operational and financial performance (Maryam and Soroosh, 2018; Margolis *et al.*, 2018). Consider the Brexit scenario, if Briton fails to achieve a trade deal with the European Union, it may lead to substantial disruptions in supply chains due to increased border checks. This scenario has induced manufacturers such as Toyota to raise alarm (Meyer, 2019). Walker (2020) reports that recent coronavirus epidemic has resulted in many international retailers such as IKEA and Starbucks closing operations in China. Many international airlines have stopped flights to China resulting in hotel chains offering refunds to customers. Given the fact that China has a pivotal role in global supply chains, the negative effects of these disruptions are global. Hyundai – South Korean car manufacturer – had to suspend car production due to the problems in the part supply from its Chinese operations (Walker, 2020). These and similar events have prompted researchers to turn their attention toward supply chain resilience (SC-Resilience) for effective mitigation of disruptions (Tukamuhabwa *et al.*, 2015; Pettit *et al.*, 2013).

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SC-Resilience is the ability of an organization to rebound after shocks (Hamel and Valikangas, 2004). It involves preventing recognizable risks, meeting business objectives in the face of disruptions and achieving the required performance level after the disruptions have occurred (Sawyerr and Harrison, 2020). SC-Resilience helps in adapting swiftly to impulsive events (Jüttner and Maklan, 2011; Adobor and McMullen, 2018) by minimizing instabilities (Bag *et al.*, 2019; Ali *et al.*, 2017). It does not merely deal with one-time crises. At the core of this capability are the organizational mechanisms that continuously anticipate and make adjustments to constant changes impairing the earning potential of an organization's businesses (Hamel and Valikangas, 2004).

As the world population increases and the climate changes become more erratic and obvious, the occurrences of supply chain disruptions are on the rise (Guha-Sapir and Ph, 2015). It has therefore become important to understand and develop SC-Resilience for the future of enterprise (Sawyerr and Harrison, 2020). An increasing number of publications have addressed SC-Resilience from various aspects. However, this literature does not present a holistic picture (Polyviou *et al.*, 2020) since it severely lacks a developing country perspective (Tukamuhabwa *et al.*, 2017). This is in spite of the fact that developing countries are the ones most affected by the supply chain disruptions whether natural calamities or man-made disasters (such as wars). Furthermore, meta-analytic evidence also suggests a relative scarcity of empirical research compared to non-empirical studies in the area (Ali *et al.*, 2017). Researchers have also highlighted the importance of integrating developments in resilience from outside SCM (Pettit *et al.*, 2019). Our study contributes toward settling some of these issues.

In this research, we study the antecedents of SC-Resilience. We suggest that supply chain ambidexterity (SC-Ambidexterity) (O'Reilly and Tushman, 2013; Gibson and Birkinshaw, 2004; Duncan, 1976) leads to SC-Resilience. The theory of ambidexterity suggests that given the rapid change in competitive and market forces, it is not sufficient anymore to achieve competitive advantage while focusing on a single objective (such as resilience *or* efficiency). Instead, it is necessary to achieve multiple seemingly contrasting objectives at the same time (i.e. resilience *and* efficiency). This means that organizations in pursuit of higher resilience cannot relinquish efficiency and vice versa. Research shows that ambidexterity in the organization leads to higher levels of dynamism (Ricciardi *et al.*, 2016), organizational performance (Boumgarden *et al.*, 2012; Junni *et al.*, 2013; O'Reilly and Tushman, 2011; Ramachandran *et al.*, 2019) and competitive advantage (O'Reilly and Tushman, 2011). While there is significant extant research on organizational ambidexterity, the research from the supply chain perspective is relatively scarce (see for some notable exceptions: Kristal *et al.*, 2010; Ojha *et al.*, 2018; Blome *et al.*, 2013a; Rojo *et al.*, 2016; Partanen *et al.*, 2020). Furthermore, SC-Ambidexterity and SC-Resilience have been rarely considered in conjunction with each other.

We further propose that supply chain agility (SC-Agility) plays a mediating role in the relationship between SC-Ambidexterity and SC-Resilience. Competitive, complex, dynamic and uncertain business environment necessitates prompt, rapid and speedy response to the market changes and customer needs (Anwer, 2017; Dubey *et al.*, 2018). This rapid and prompt response is best achieved through SC-Agility (Brusset, 2016). SC-Agility leads to a faster response to changing conditions (Christopher and Peck, 2004) and variations in mitigating risk and the market response (Braunscheidel and Suresh, 2009). By adopting SC-Agility, firms can reduce instabilities and improve their response capacity exclusively in a dynamic environment (Fayezi *et al.*, 2015, 2017; Swafford *et al.*, 2008).

We use the dynamic capabilities view (DCV) as a theoretical anchor for this study (Teece, 2007; Eisenhardt and Martin, 2000; Teece *et al.*, 1997). DCV suggests that in order to survive and sustain competitive advantage in constantly changing market conditions, firms require dynamic capabilities (Teece *et al.*, 1997). O'Reilly and Tushman (2013) suggested that DCV is

the most pertinent theoretical frame for the study of SC-Ambidexterity. Similarly, several studies have used DCV in the study of SC-Agility (e.g. Russell, 2015; Blome *et al.*, 2013b; Gligor *et al.*, 2015). We theorize that SC-Ambidexterity affects SC-Resilience and SC-Agility mediates this relationship. Furthermore, in line with the DCV, we suggest that the Ambidexterity–Resilience relationship is modified by the environmental uncertainty which plays a moderating role in this relationship.

This study contributes to research streams in the areas as diverse as DCV, SC-Ambidexterity and SC-Resilience. Prior research has shown that dynamic capabilities are necessary to achieve SC-Resilience (Gunessee *et al.*, 2018). Thus, by suggesting a supply chain-related capability (i.e. SC-Ambidexterity) that contributes to SC-Resilience we contribute to both dynamic capabilities and the SC-Resilience literature. We contribute to the literature in the area of SC-Ambidexterity by providing a unique operationalization for SC-Ambidexterity. We model SC-Ambidexterity as contextual ambidexterity, taking the line of argument suggested by Gibson and Birkinshaw (2004) into the supply chain context and suggest that the ability to balance exploitation and exploration is context-dependent and may require supply chains to distribute time and resources between the objectives of supply chain adaptability (SC-Adaptability) and supply chain alignment (SC-Alignment). We thus contribute toward the enrichment in the theory of ambidexterity.

The remaining part of this paper is organized in the following manner. The next section presents a review of the relevant literature and research hypotheses. Section 3 provides the details of the methods employed in this study. Section 4 includes the details of measurement and structural model evaluation. Section 5 concludes this study by providing the discussion of results along with its implications.

2. Literature review

2.1 Supply chain resilience

Recent years have seen an increase in major disasters such as terrorist attacks, tsunami's in Asia and the United States that have adversely disrupted the supply chains. This has diverted the attention toward resilience. The need for resilience arises from the premise that all risks cannot be avoided and firms can overcome disruption threats to their supply chains by developing resilience that allows them to carry on providing goods and services to the customers (Tukamuhabwa *et al.*, 2017; Sahebjamnia *et al.*, 2018; Bhamra *et al.*, 2011). Resilient firms are relatively better prepared to deal with disruptions and organize internal resources, capabilities and systems in a better way in the face of disruptions (Ambulkar *et al.*, 2015; Ponomarov and Holcomb, 2009; Martins de Sá *et al.*, 2019).

The extant literature on SC-Resilience suggests that environmental uncertainties and disruptions are not restricted to organizational boundaries; rather they impact the entire supply chain. It is therefore critical for the firms to develop capabilities that are aligned with their supply chain partners in order to overcome both anticipated and sudden changes (Chowdhury and Quaddus, 2017; Ponomarov and Holcomb, 2009; Ali *et al.*, 2017). SC-Resilience is defined as the "capability of a supply chain to develop the required level of readiness, response, and recovery capability to manage disruptions risks, get back to the original state or even a better state after disruptions" (Chowdhury *et al.*, 2019, p. 659). It is implemented through the balance of buffer-oriented and process-oriented strategies (Zsidisin and Ellram, 2003). Buffer-oriented strategies (such as keeping safety stock, sourcing from multiple suppliers) are based on developing surplus or redundant resources (Vanpoucke and Ellis, 2020). Even though these strategies limit the supply chain loss due to disruption, they do little to reduce the probability of these disruptions and contribute to the inefficiencies (Vanpoucke and Ellis, 2020; Talluri *et al.*, 2013). The process-oriented strategies are based on developing the ability to sense possible disruptions through appraising, monitoring and

certifying suppliers (Vanpoucke and Ellis, 2020). These strategies are executed based on capabilities such as flexibility, visibility, collaboration and redundancy (Ali *et al.*, 2017; Chowdhury *et al.*, 2019; Brandon-Jones *et al.*, 2014; Zsidisin and Wagner, 2010).

Resilient supply chains can anticipate and curtail the negative effects of disruptive events while reducing the time of recovery to normal activity in a meaningful way (Ruiz-Benítez *et al.*, 2018). Firms that are better able to minimize the duration and severity of disruptions to their supply chains relative to the competitors are more resilient (Christopher and Peck, 2004; Scholten *et al.*, 2020) and are able to use it as a strategic weapon to achieve competitive advantage (Scholten *et al.*, 2020). Research shows that besides overcoming disruptions, SC-Resilience can directly influence performance outcomes of the organization (Kwak *et al.*, 2018; Birkie *et al.*, 2017; Wieland and Wallenburg, 2013; Chowdhury *et al.*, 2019; Chunsheng *et al.*, 2020; Altay *et al.*, 2018).

2.2 Supply chain ambidexterity

A stream of the literature in organization studies suggests that organizations come across a trade-off quite frequently where actions best for the short-term success are not necessarily best for the long-term (Laverty, 1996). Looking at the problem of "inter-temporal choice" this way emphasizes the importance of long-term versus short-term focus or long-term versus short-term orientation (Lumpkin and Brigham, 2011; Miller and Le Breton-Miller, 2005; Souder and Bromiley, 2012). The literature in the area of organizational ambidexterity, however, points out that apparently conflicting objectives can indeed be reconciled (Wang *et al.*, 2019). The need for ambidexterity arises out of the fact that firms have a need to adapt according to the dynamic market for long-term success while at the same time duplicate their existing business models for the short-term success (Hershcovis, 2011).

Most empirical research models' ambidexterity is a trade-off between exploration and exploitation (Partanen *et al.*, 2020; Blome *et al.*, 2013a; Kristal *et al.*, 2010; Im and Rai, 2008). It has been termed as structural ambidexterity (O'Reilly III and Tushman, 2013). Exploration related practices are geared toward targeting new possibilities and involve search, risk-taking and innovation. Exploitation practices, on the other hand, target efficiency, improvement and implementation (March, 1991). Organizational practices focused on exploration target long-term success whereas those targeting exploitation are focused on short-term outcomes (Wang *et al.*, 2019). Researchers have argued that in order for firms to survive and thrive in the dynamic markets, these practices need to be adopted simultaneously (March, 1991, March, 2003, Tushman and O'Reilly III, 1996).

Gibson and Birkinshaw (2004) introduced the idea of *contextual* ambidexterity. They argued that in order to meet contradictory demands of exploration/exploitation or efficiency/responsiveness, the firm's context in terms of its processes and systems plays a critical role. They described contextual ambidexterity as a "behavioral capacity to simultaneously demonstrate alignment and adaptability across an entire business unit" (p. 209). In this study, we adopt the relational view of the contextual ambidexterity suggested by Hill and Birkinshaw (2014). According to the relational view, the resources important for the supply chain firms to generate super-normal profitability are embedded in the process, routines and inter-organizational relationships of the supply chain firms (Schilpzand *et al.*, 2016; Im *et al.*, 2019; Ardito *et al.*, 2019). It is this context that facilitates the needed resource flows to build new capabilities while simultaneously capitalizing on the existing ones (Hill and Birkinshaw, 2014).

We conceptualize contextual ambidexterity at the supply chain level as a combination of SC-Alignment and SC-Adaptability. In line with Lee (2004), SC-Adaptability is a firm's ability to modify supply chain design in order to accommodate structural changes in the market and adjust the supply network according to strategies, technologies and products. SC-Alignment

is the ability to align the incentives of supply chain partners to improve supply chain performance. SC-Ambidexterity is thus *the ability to modify supply chain design to adapt according to the market changes while aligning the incentives of the supply chain partners*. Even though the researchers have recognized the difficulty of managing alignment and adaptability simultaneously, they have argued that ability to do this leads to long-term competitive advantage (Liu *et al.*, 2018; Gibson and Birkinshaw, 2004; Cao *et al.*, 2009; He and Wong, 2004).

We hypothesize that SC-Ambidexterity antecedes SC-Resilience. SC-Resilience balances the ability to stop disruptions from occurring and the ability to overcome the negative effects *after* these disruptions have occurred (Vanpoucke and Ellis, 2020). SC-Ambidexterity contributes toward SC-Resilience as ambidexterity underlies mechanisms that antecede resilience. SC-Adaptability constitutes the ability to develop redundancies in the supply chains through continuous development of fresh suppliers and logistics infrastructure (Lee, 2004). This allows the supply chain to overcome supply-side disruptions (Vanpoucke and Ellis, 2020). It also involves developing management systems that can evolve rapidly (Gibson and Birkinshaw, 2004) leading to the effectiveness of mitigation strategies. Previous research has also shown that adaptability leads to SC-Resilience (Pettit *et al.*, 2010; Ali and Gölgeci, 2019). Similarly, SC-Alignment underlies the equitable sharing of risks amongst the supply chain partners (Lee, 2004) and uniting the work efforts throughout the supply chain (Gibson and Birkinshaw, 2004). This motivates the supply chain partners to work together toward preventing and mitigating disruptions. We thus posit that:

H1. Supply chain ambidexterity positively impacts supply chain resilience.

2.3 The mediating role of supply chain agility

SC-Agility is "the supply chain's ability to quickly adjust its tactics and operations. This ability can manifest itself proactively or reactively" (Gligor and Holcomb, 2012, p. 296). SC-Agility allows firms to modify routines and adjust according to changing conditions (Swafford *et al.*, 2006) such as supply chain disruptions. It helps match the organization's response to environmental uncertainty in an accurate manner (Tavani *et al.*, 2013).

In this study, we suggest that SC-Agility mediates the relationship between SC-Ambidexterity and SC-Resilience. Both adaptability and alignment components of SC-Ambidexterity are positively related to SC-Agility. SC-Adaptability involves the ability to reconfigure the supply chain by identifying new suppliers and markets, continuous development of suppliers and infrastructure and developing management systems throughout the supply chain that are flexible and responsive to the changes in the market (Lee, 2004; Gibson and Birkinshaw, 2004). These activities are central to the success of SC-Agility that entails rapid response to the market changes without major penalty in cost or time. Aslam *et al.* (2018) empirically showed that SC-Adaptability leads to SC-Agility. Similarly, alignment requires sharing costs and benefits of improvement initiatives and working on unified objectives throughout the supply chain (Lee, 2004; Gibson and Birkinshaw, 2004). SC-Agility requires enhanced cooperation and dependability between the supply chain partners so that the overall cost of receptiveness and response time to fulfill the changing customer requirements can be minimized. Previous research has also shown a positive relationship between alignment and agility (Zhou *et al.*, 2018).

SC-Agility is also positively related to SC-Resilience. This link of our proposed mediation relationship is also confirmed in the previous research (Iborra *et al.*, 2020; Lee and Rha, 2016). SC-Agility is especially important during disruption when it allows knowledge sharing and collaboration activities to take place between the supply chain partners (Scholten *et al.*, 2020). Supply chains with greater SC-Agility are able to sense the environmental threats (possibility of disruptions) in a better way (Teece, 2007) and respond to them using their collaborative

supplier network, redundant resources and their collaborative infrastructure for risk response. All these activities allow firms to become more resilient. We therefore propose that SC-Ambidexterity affects the SC-Resilience through the positive mediation of SC-Agility.

H2. Supply chain agility mediates the relationship between supply chain ambidexterity and supply chain resilience.

2.4 The moderating role of uncertainty

Where there is a dearth of any knowledge either internally or externally in an organization, the issue of uncertainty arises. External uncertainty is usually referred to as environmental uncertainty; the volatile external environment of firms (Kreye, 2017). Researchers that define uncertainty as an unanticipated or unpredicted environment claim that uncertainty itself is not an issue until it interacts with the vital elements of firms affecting their efficacy (Gadde and Finn, 2018). Ritchie and Brindley (2007), state that there is always a substantial amount of uncertainty that impacts a supply chain.

A major stream of the literature on dynamic capabilities suggests that these capabilities are only relevant in a dynamic environment (Teece *et al.*, 1997; Teece, 2014; Drnevich and Kriauciunas, 2011; Wilhelm *et al.*, 2015). Teece (2007) reiterated the special relevance of dynamic capabilities in dynamic environments. By definition dynamism in a firm's environment requires it to change (Drnevich and Kriauciunas, 2011) bringing about the need for the application of dynamic capabilities. Firms operating in dynamic environments need to capitalize on the opportunities by modifying their operating routines according to the changing demand patterns (Wilhelm *et al.*, 2015). This is achieved through dynamic capabilities such as SC-Ambidexterity. Environmental uncertainty is an important component of market dynamism. We, therefore, hypothesize that the impact of SC-Ambidexterity on SC-Resilience will be higher in the case of higher market uncertainty and vice versa. The following hypothesis is posited:

H3. Uncertainty moderates the relationship between supply chain ambidexterity and supply chain resilience in a way that a higher level of uncertainty enhances the positive impact of supply chain ambidexterity on supply chain resilience (see Figure 1).

3. Research methods

In this section, we describe the methods employed for data collection and validation. We used a deductive research approach given the fact that we were testing hypotheses drawn from an existing theory, i.e. DCV (Reyes, 2004). In line with the common approach of theory testing studies, we used survey research. We surveyed the manufacturing industries of Pakistan. Pakistan provides a suitable context for the study of SC-Resilience and dynamic capabilities. During the last two decades country has been on the receiving end of several natural and man-made disasters. In terms of natural calamities, Pakistan has spent in access of $10 bn during the last decade or so on disaster relief and recovery (GFDRR, 2019). Pakistan ranks 33rd amongst the global emitters (The Global Economy, 2019) yet it's the seventh country in the world most affected by climate change (Ahmed, 2019). Terrorism ensuing after the global war on terror has also had a devastating effect on the country. An estimate shows that till 2017–18, Pakistan faced losses of $126.79 bn in the war on terror (Mustafa, 2018). These disruptions combined with the threat of war with neighboring country India create many issues for supply chain managers regarding the security of goods and raw materials. For example, after a recent stand-off with India, the government of Pakistan imposed a blanket ban on Indian imports. This affected the pharmaceutical supply chains adversely since many

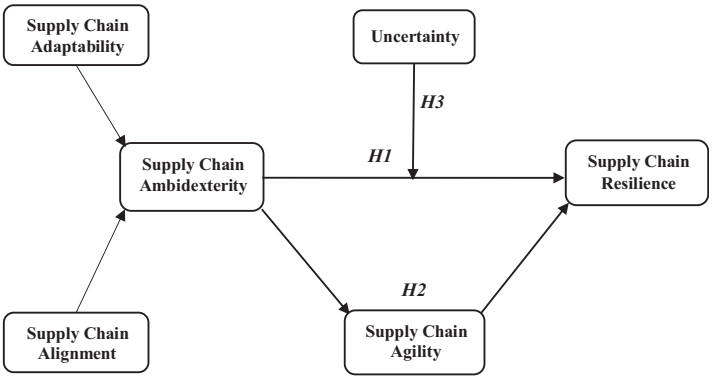

Figure 1.
Hypothesized model

of the raw materials used in life-saving drugs were being imported from India. All these facts mean that developing SC-Resilience needs to be an important element of firm strategy in Pakistan.

3.1 Sample and data collection

As mentioned before we collected data from the Pakistani manufacturing sector. There are several problems of data collection in developing countries that are well documented in previous research (Awan, 2009; Russell, 2015; Hoskisson *et al.*, 2000; Malik and Kotabe, 2009). We faced these problems such as unavailability of the sampling frame, trust deficiency toward researcher, inaccessibility to the higher officials and knowledge dearth among the managers of different disciplines. Besides, there was no single platform where a consolidated list of all manufacturing firms in Pakistan was available. An effort was put in to prepare a list of manufacturing firms by consulting Pakistan Stock Exchange listings as well as yellow pages. After sorting out the electronic mail identifications of various firms, a series of requests, via electronic mails, were floated for attempting the survey in the period from July 2018 to November 2018. The questionnaire along with a cover letter, briefly describing the important terminologies and importance of the survey, was forwarded to 1730 respondents followed by regular reminders on a fortnightly basis. Out of these 1730 requests, only 67 responses (3.87% response rate) were received. The discouraging response on electronic mail paved the way for the use of an alternative method of snowballing. Through this technique, 62 usable responses were received. Therefore the data collection effort resulted in 129 usable responses. The description of firms in the sample is provided in Table 1 whereas the description of respondents is provided in Table 2.

3.2 Measures

Our research included variables that were not readily available from the annual reports of the firms. Due to this reason, we used perceptual measures to operationalize the constructs. We used existing measures for the constructs of interest in this study (Schminke, 2004). Relevant scales were identified after a comprehensive literature survey. Based on this literature search, scales demonstrating suitable validity and reliability were identified. We provide the details of these scales in the following section.

Supply chain ambidexterity: We measured SC-Ambidexterity as a second-order formative construct by using SC-Adaptability and SC-Adaptability as its first-order indicators. Both first-order constructs were measured on the scale of 1 (strongly disagree) to 7 (strongly agree).

The items of SC-Adaptability and SC-Adaptability were adopted from the work of Gibson and Birkinshaw (2004) and Whitten *et al.* (2012).

Supply chain agility: We used SC-Agility as a mediator between SC-Ambidexterity and SC-Resilience. The items for SC-Agility were adopted from Whitten *et al.* (2012) and were measured on the scale of 1 (strongly disagree) to 7 (strongly agree).

Uncertainty: We used uncertainty as a moderator between SC-Ambidexterity and SC-Resilience. The items of the scale were measured on the scale of 1 (not at all) to 5 (completely) and were adopted from the work of Hoffmann *et al.* (2013).

Supply chain resilience: The dependent variable for this study is measured on the scale of 1 (strongly disagree) to 7 (strongly agree). The items of SC-Resilience are adopted from Ambulkar *et al.* (2015).

3.3 Common method bias

We elicited data for independent and dependent variables from the same respondent in the study. This could result in the common method bias (CMB, Podsakoff *et al.*, 2003). We took pre-emptive measures to avoid CMB. Followed the guidelines by Conway and Lance (2010) and Podsakoff *et al.* (2003), we placed dependent and independent variables in different sections of the survey and with different Likert-type scales; for example, not at all-completely versus strongly disagree-strongly agree. We assured the respondents about their anonymity in results and also provided them the option of submitting anonymous responses.

We also used statistical measures to detect CMB. First, we used Harman's single-factor test. We loaded all the items on one factor without applying any rotation. The results showed that maximum variance explained by a single factor as 38%. Thus, a single factor did not

Table 1. Organization representation in the sample

Industry	Frequency	%
Textile	28	21.7
FMCG	15	11.6
Surgical instruments	9	6.97
Footwear	13	10.0
Sports goods	4	3.10
Auto parts/manufacturing packaging	7	5.42
Food and beverages	3	2.32
Glass	13	10.0
Rubber and tires	11	8.52
Others	6	4.65
Not provided	20	15.5
Organization history		
1–5 years	16	12.4
6–10 years	15	11.6
11–20 years	22	17.0
21–25 years	19	14.7
26 years and above	54	41.8
Not provided	3	2.3
Sales (in PKR)		
1–10 m	5	3.87
11–50 m	8	6.20
51–100 m	21	16.27
101–200 m	21	16.27
Greater than 200 m	65	50.38
Not provided	9	6.97

Designation	Frequency	Percentage
CEO/general manager	10	7.75
Senior manager	2	1.55
Manager/deputy manager	36	27.90
Assistant/middle manager	24	18.60
Others	52	40.31
Not provided	5	3.87
Experience		
1–5 years	63	48.83
6–10 years	33	25.58
11–20 years	24	18.60
21 years and above	7	5.42
Not provided	2	1.5

Table 2. Respondent description

explain most of the variation. Second, we tested CMB using Smart PLS 3 in which a collinearity test was performed on all five constructs of the model. The test result value of variance inflation factors (VIFs) generated for all the latent variables were <3.3 indicating that CMB is not a significant issue in this study (Kock, 2015).

4. Results

Data analysis in this study was performed in two stages. In the first stage, we performed the measurement model evaluation through confirmatory factor analysis (CFA). In the second stage, we tested the hypothesized model using structural equation modeling (SEM). We use partial least squares structural equation modeling (PLS-SEM) in both the stages. PLS-SEM provides flexibility regarding the distributional properties of the sample as well as the sample size; however, we used PLS-SEM due to the formative nature of the SC-Ambidexterity construct (Hair *et al.*, 2017).

4.1 Assessment of psychometric properties

In order to validate the measurement model, we performed the CFA on all the first-order constructs of the study. We further assessed the Cronbach's α to assess the internal consistency of the constructs. Alpha coefficients of all the constructs exceeded the value of 0.7 signifying the reliability of the constructs. We used the Fornell-Larcker criterion to establish convergent and discriminant validity (Fornell and Larcker, 1981). Factor loadings for all the constructs stretched from 0.54 to 0.90. Items with low loadings were deleted. Final loadings on each factor averaged to about 0.71. Average variance extracted (AVE) values ranged between 0.52 and 0.72 (>0.5) providing the evidence of convergent validity. Table 3 provides information about Cronbach's α, factor loadings, and AVEs.

To measure discriminant validity, we compared the square root of AVE for each construct to its bivariate correlations with all constructs. The square root of AVE in each case was higher than all the corresponding correlations providing the evidence for discriminant validity (Fornell and Larcker, 1981). Table 4 provides evidence for discriminant validity along with the construct means and standard deviations.

4.2 Assessment of the structural model

The results of the structural model are provided in Figure 2. In our model, SC-Ambidexterity was a second-order formative construct. To measure SC-Ambidexterity, we modeled it as a formative-reflective combination of SC-Alignment and SC-Adaptability. In Figure 2, path

Variables with Cronbach's α, and average variance extracted	Outer loadings
Supply chain adaptability (α = 0.849, AVE = 0.524)	
SAD 1	0.708
SAD 2	0.689
SAD 3	0.701
SAD 4	0.748
SAD 5	0.764
SAD 6 (Deleted)	–
SAD 7	0.723
SAD 8	0.731
Supply chain alignment (α = 0.851, AVE = 0.696)	
SAL 1 (Deleted)	–
SAL 2	0.709
SAL 3 (Deleted)	–
SAL 4	0.859
SAL 5	0.86
SAL 6	0.896
Supply chain agility (α = 0.829, AVE = 0.543)	
SAG 1	0.852
SAG 2	0.812
SAG 3	0.586
SAG 4	0.680
SAG 5	0.675
SAG 6	0.782
Uncertainty (α = 0.764, AVE = 0.619)	
U1	0.902
U2	0.870
U3	0.535
Supply chain resilience (α = 0.869, AVE = 0.718)	
SRE 1	0.825
SRE 2	0.872
SRE 3	0.866
SRE 4	0.826

Table 3. Measurements for construct reliability and convergent validity

coefficients with solid lines indicate significant relationships, whereas, dotted lines indicate insignificant relationships. To evaluate the significance of path coefficients, PLS bootstrapping with 5,000 samples was carried out (Hair *et al.*, 2017). The VIF values of all predictor constructs ranged between 1.0 and 2.584, not exceeding the threshold of 3.3 (Kock, 2015), thereby demonstrating no issues in multicollinearity among predictor constructs. The model fit index of standardized root mean squared residual (SRMR) is 0.71 (less than the cut-off value of 0.8) concluding that there is a good fit between the hypothesized model and the observed data (Henseler and Ray, 2016). The construct cross-validated redundancy index (Q^2) was evaluated by applying the blindfolding procedure in Smart PLS 3. The outcomes for endogenous constructs, SC-Resilience (0.34) and SC-Agility (0.294), exceed zero depicting an acceptable predictive relevance of the model (Hair *et al.*, 2017).

Results for the hypotheses show that SC-Ambidexterity has a positive impact on SC-Resilience ($\beta = 0.496$, $p < 0.01$), in support of H1. In hypothesis 2, we suggested that SC-Agility will mediate the Ambidexterity–Resilience relationship. Our results show that H2 is also supported ($\beta = 0.212$, $p < 0.01$). While testing the moderation effect hypothesized in H3, our results show that the interaction of uncertainty with SC-Resilience was not significant.

(β = 0.013, p > 0.05). Hence H3 was not supported. These results are discussed in the following section.

5. Discussion and implications

5.1 Theoretical implications

We modeled SC-Ambidexterity as *contextual* ambidexterity combining SC-Alignment and SC-Adaptability (Gibson and Birkinshaw, 2004). Context is composed of systems and processes that shape behaviors in supply chains (Ghoshal and Bartlett, 1994). This context needs to be designed so that each supply chain partner can optimize its time and efforts between the demands of adaptability and alignment (Raisch and Birkinshaw, 2008). An in-depth analysis of the results suggests that the organizations should follow the ambidextrous strategy encompassing adaptability and alignment by keeping a balance between the two to minimize the effects of supply chain disruptions. Our study, therefore, contributes to the growing body of knowledge in the area of supply chain management and dynamic capabilities as it identifies a set of domains (adaptability and alignment) where the efforts of supply chain partners can lead to ambidexterity. By elucidating the interdependent nature of SC-Adaptability and SC-Alignment, we extend research on these capabilities that have considered them independently (e.g. Aslam *et al.*, 2018; Dubey *et al.*, 2018). A major contribution of this study is that it presents a novel way of measuring contextual SC-Ambidexterity in the supply chains. Prior research in the management field shows that the strength of the supply network plays a central role in developing and successfully overcoming the tensions arising due to the management of conflicting capabilities (Wang *et al.*, 2019). We, therefore, identify conflicting capabilities (adaptability and alignment) in the

Construct	Mean	SD	1	2	3	4	5
Supply chain adaptability	4.96	1.12	***0.724***				
Supply chain agility	4.89	1.13	0.717**	***0.737***			
Supply chain alignment	4.99	1.19	0.723**	0.716**	***0.834***		
Supply chain resilience	4.94	1.19	0.658**	0.654**	0.64**	***0.848***	
Uncertainty	3.16	0.90	0.261**	0.166**	0.193**	0.133**	***0.787***

Note(s): The values in bold and italic numerals illustrate the square root of the AVE. ** significant at 0.01 level (two-tailed)

Table 4. Assessment of discriminant validity

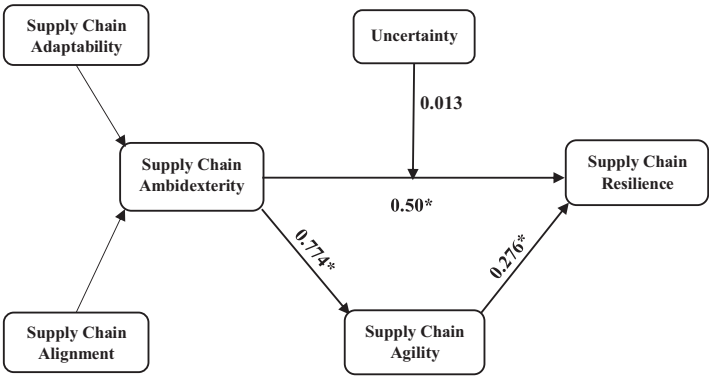

Figure 2. Structural model

supply chains that contribute toward supply chain success. We thus contribute to the dynamic capabilities literature in the area of the supply chain by describing contextual ambidexterity from the supply chain perspective and extending the work by the previous researcher with organizational focus (Gibson and Birkinshaw, 2004; Hill and Birkinshaw, 2014). We show that SC-Ambidexterity is an effective mechanism in achieving SC-Resilience.

From the testing of hypothesis 1, we found that SC-Ambidexterity has a positive impact on the SC-Resilience. The significance of SC-Ambidexterity has been previously recognized in terms of performance (Chandrasekaran *et al.*, 2012; Blome *et al.*, 2013a), flexibility (Patel *et al.*, 2012) and knowledge sharing (Im *et al.*, 2019). Our study extends this body of work to SC-Resilience. Firms possessing dynamic capabilities (such as SC-Ambidexterity) possess environmental awareness which allows them to achieve resilience through the reconfiguration of their resource-base when facing disruptions (Ambulkar *et al.*, 2015). Our study also extends the previous research on the relationship between structural ambidexterity and resilience (e.g. Iborra *et al.*, 2020; Lee and Rha, 2016) by considering the role of *contextual* ambidexterity in developing SC-Resilience. Doing so, we contribute to the literature in the areas of ambidexterity and resilience.

We further find that SC-Agility mediates the relationship between SC-Ambidexterity and SC-Resilience. By showing empirical support for the mediating role of SC-Agility, our study provides a mechanism through which SC-Ambidexterity contributes to the organization's survival especially in the face of supply chain disruptions. We add to the work of Tuan (2016) by proposing the performance outcomes of SC-Ambidexterity and SC-Agility relationship. Our study extends Altay *et al.* (2018) study who researched the relationship between SC-Agility and SC-Resilience on disaster recovery performance. They, however, did not consider the interrelationship between the two constructs. Our results show that SC-Agility provides a mechanism through which SC-Resilience can be achieved.

While investigating the moderation effect of uncertainty on the relationship between SC-Ambidexterity and SC-Resilience, we found no significant effect. This was startling because many leading researchers in the area of dynamic capabilities have argued that dynamism is an important environmental element for the positive effect of dynamic capabilities (Teece, 2014; Drnevich; Kriauciunas, 2011; Wilhelm *et al.*, 2015) i.e. dynamic capabilities perform better in an uncertain environment. Our results, however, do not suggest that uncertainty does not affect the Ambidexterity–Resilience relationship. They only provide evidence that this relationship remains the same at all levels of uncertainty. Indeed most of the manufacturing organizations in the developing countries are focusing on minimizing the chronic threats of disruption by implementing resilience as a strategy (Benjamin *et al.*, 2017). The awareness of threats and successful adoption of remedies by these firms in their supply chain also minimizes the influence of uncertainty.

Our results also provide support for the triple-A (*agility, adaptability, and alignment*) supply chain model of Lee that suggests a positive relationship between triple-A supply chain and supply chain performance (Lee, 2004). Many studies since have validated the triple-A model (Whitten *et al.*, 2012; Attia, 2015; Marin-Garcia *et al.*, 2018; Dubey *et al.*, 2018). However, the present study is probably the first that has shown the effect of the triple-A supply chain in terms of resilience. Furthermore, most of these studies have considered the simultaneous effect of triple-A supply chain practices. In this study, we provide an order in which these practices need to be activated to influence performance (Russell, 2015) i.e. SC-Adaptability and SC-Alignment need to be activated before the SC-Agility in order to achieve SC-Resilience.

Our research also provides an empirical test of the dynamic capabilities-performance relationship. We identify dynamic capabilities that lead supply chains toward resilience. These results also show the relevance of dynamic capabilities in developing countries. Many previous researchers have shown dynamic capabilities to be relevant only in a fast-paced

environment. Our results show that dynamic capabilities are as relevant in developing countries as they are in developed ones. This is because competition and fast-paced innovation is only one aspect of dynamism. Another aspect is vulnerability to disruptions. This aspect is more common or more severe in developing countries. Therefore, firms in developing countries need to invest in developing dynamic capabilities (such as SC-Ambidexterity) if they want to survive in the face of constant disruptions if they want to avoid vulnerability.

5.2 Managerial implications

In line with the previous research, we conclude that the benefits of ambidexterity go beyond the firm boundaries (Blome *et al.*, 2013a; Tuan, 2016). Prior research also indicates the importance of combined action by the supply chain partners in case of disruptions (Sawyerr and Harrison, 2020; Pettit *et al.*, 2019) to achieve SC-Resilience. Thus, the supply chain orientation is important for the success of both capabilities. Firms in a supply chain, therefore, need to make combined efforts for survival in the face of disruptions. Managers are generally aware of the problems associated with supply chain disruptions and the importance of SC-Resilience (Scholten *et al.*, 2020). However, their understanding of the role SC-Ambidexterity plays in achieving SC-Resilience might be less perfect. This study shows the importance of SC-Ambidexterity in developing in achieving SC-Resilience.

Contextual ambidexterity in supply chains necessitates a management system that can create synergies between SC-Alignment and SC-Adaptability in terms of goals, activities and resources of supply chain partners (Im and Rai, 2014; Gibson and Birkinshaw, 2004). Our results show that SC-Ambidexterity is a capability that not only affects the performance outcomes of the organizations (Wamba *et al.*, 2019) but is also used to develop other capabilities such as SC-Agility and SC-Resilience. Thus, our results inform the practice by suggesting the order in which capabilities need to be developed and executed. The pursuit of SC-Ambidexterity and SC-Agility in supply chains helps in developing an organization's response to disruptions in the form of SC-Resilience which ultimately improves the operational and economic performance of these firms (Ruiz-Benítez *et al.*, 2018). Resilience in its manifestation cannot just occur to any organization. It is the capacity that needs to be cultivated, maintained and implemented by the successful deployment of dynamic capabilities such as SC-Ambidexterity in order to respond quickly to the market disruptions.

Our results reflect the guidelines for developing resilient supply chains. Supply chain managers can use the outcomes of this research by implementing SC-Ambidexterity to achieve resilience for countering supply chain disruptions. Managers can take advantage of using ambidextrous orientation for adapting, integrating, renewing and recreating firm resources, capabilities and core competencies in response to the disruptive environment to attain a competitive advantage. The manufacturing organizations in developing countries may not afford to establish a disaster management cell to counter disruptions due to a lack of resources. This study provides an opportunity for the managers of resource-constrained firms to efficiently pursue contemporary business while still improve existing resources by adopting contextual ambidexterity (Gibson and Birkinshaw, 2004).

5.3 Limitations and future research directions

The results of this study should be interpreted while considering its limitations. Overcoming these limitations in future studies may provide an opportunity for future research. The relatively small sample size was a limitation considering the cross-sectional nature of the study. We made an effort to establish the generalizability by ensuring maximum representations of major industrial sectors of industries. However, non-response bias

cannot be ruled out. We conducted the study in a developing country environment. Even though the issues discussed in the study are relevant for both developing and developed countries, the scale of resources brought to address these problems is significantly different. Caution should, therefore, be observed when generalizing the results of this study beyond a developing country environment.

We based this study in the context of the manufacturing industry. Therefore, these results cannot be generalized to the service supply chains. This does not mean that service supply chains are devoid of disruptions. The nature of constructs used in this study requires separate operationalization for manufacturing and service supply chains. Future research may consider operationalizing the major constructs of this study into the context of the services and replicating this research model.

We used a single informant research design while collecting self-reported perceptual data. We applied adequate pre-emptive procedures that were applied for data collection. Subsequently, we performed statistical procedures for detecting CMB. However, we cannot rule out the possibility of CMB from this study. Future studies may use multiple informant data on this research model to get definitive evidence on the hypothesized relationships. Lastly, in this study, we considered the uncertainty of the environment as a representation of market dynamism. Given the importance of this concept in the context of dynamic capabilities, other sources of dynamism such as competition, technology, innovation, etc. may also be considered.

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